Financing Strategy for On-Grid Solar PV in Cement & Construction Industry: PT CBS Indonesia Case

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ABSTRACT

In Indonesia, the cement industry plays an important for the development of infrastructure, as this industry keeps expanding along with infrastructure development projects and urban areas. This study analyzes the financing strategy for on-grid solar PV installation with a case study of PT Cibinong Bangun Sarana by using financial feasibility analysis, sensitivity analysis, capital budgeting, and US Index. The results show that an international bank loan with a debt-to-equity ratio of 40%:60% is the most optimal financing strategy. This study provides strategic insights for cement companies in implementing sustainable energy solutions, reducing electricity costs, and improving operational efficiency.

INTRODUCTION

In Indonesia, the cement industry plays an important for the development of infrastructure, including the construction of roads, bridges, and high-rise buildings. This industry keeps expanding in line with the rapid pace of major infrastructure development projects and the growth of urban areas in need of new housing (Ordonez et *al*., 2021; Andrea, 2015). With nationwide total consumption ranging from approximately 13.5 to 18.3 million tons per quarter in 2022 and 2023 in 2020 Indonesia (BPS, 2023). By 2024, this market was expected to rise to USD 410.86 billion from USD 386.18 billion with a compound annual growth rate (CAGR) of 6.4% (Revo, 2024). This market will grow to 86.31 million tons by 2033 at a CAGR of 2.8% (GlobeNewswire, 2024). This is all driven by the massive investments in infrastructure development.

However, the cement industry has encountered several obstacles, such as oversupply in the market. In 2022, the domestic demand would only require around 63 million tons of cement per year. Meanwhile, 119.1 million tons of cement are being produced. This resulted in an oversupply of 53.6 million tons, which led to intense price competition and reduced producer profits (SIG, 2023). The main causes of this cement oversupply are the property sector's stagnant growth and the delays in infrastructure projects. In addition, businesses in this industry require a high level of energy intensity to operate. The cement business uses a lot of energy; on average, 30–40% of production expenses are related to energy. Energy consumption is estimated at 2% of the world's total and almost 5% of the industry's total (Szabo et al., 2003). The significant dependency on PLN electricity and fossil fuels like coal is challenging for cement manufacturers, especially because of price fluctuation and energy supply uncertainty (IEA, 2021). In addition, in line with Indonesia's goal of reducing carbon emissions by 29% by 2030 with the Paris Agreement, there is also international pressure to do so (Ministry of Environment and Forestry, 2021).

PT Cibinong Bangun Sarana (CBS) is a company in Indonesia whose majority shares are owned and managed by an Indonesian State Own Enterprise (SOE) as the parent company. PT CBS operates an integrated business consisting of cement, ready-mix concrete, aggregates, and waste management services with a total capacity of 14.86 million tons of cement per year. PT CBS faces major challenges in maintaining operational efficiency and managing production costs. In 2024, clinker production volume only reached 832,637 tons, or 88% of the target, despite an increase compared to the previous year (103%). Similarly, cement production volume reached 1,293,587 tons, or 88% of the target, but increased to 108% compared to last year. The decrease in the achievement of the RKAP was mainly due to three main factors: disruption of the PLN power grid (42%), declining market demand (37%), and equipment damage (21%).

Electrical issues were the biggest cause of downtime, accounting for 1,057 hours of downtime or lost production of 132 thousand tons of cement products. The significant dependency on PLN for electricity supply not only affected operational stability but also increased electricity costs, which recorded an increase to IDR 1,446/kWh from IDR 1,115/kWh. In addition, fuel costs increased due to higher coal prices (IDR 1,248 million/ton) from 1,148 million/ton in the previous year. According to the Ministry of Energy and Mineral Resources (ESDM), 2024, it will reach USD 122,51 per ton, or IDR 1,985 million per ton, at the end of 2024. It happens while PT CBS's maintenance costs also rise due to damage to the kiln inlet. This condition caused total production cost to increase to IDR 789,048 million, lower than the target but higher compared to the previous year (107% higher). Total production cost per ton was also higher (IDR 609,969 per ton) compared to the target, indicating the pressure on cost efficiency caused by lower production volume and price impact.

In facing this challenge, PT CBS needs to take strategic steps to reduce dependence on PLN and fossil fuels. One of the proposed solutions is the implementation of an on-grid solar PV system that has a capacity of 1,881 MWp and is capable of generating 2,821,500 kWh per year. This technology can not only improve operational stability by providing an alternative energy source but also has the potential to lower electricity costs in the long term and support the company's sustainability commitments. With a total investment of IDR 13–14 billion, PT CBS needs to evaluate appropriate financing sources, either through internal equity financing, domestic bank loans, international bank loans, or leasing. This study aims to help PT CBS design an effective and efficient financing strategy for the solar PV project, considering factors such as cost of capital, investment risk, and potential returns. The study will also identify key challenges in financing renewable energy projects in the cement industry and provide strategic recommendations accordingly.

RESEARCH METHOD

A quantitative methodology will be used to conduct the study, mostly through desktop research. The quantitative method is the collection and analysis of numerical data to address scientific research questions (Rana et *al., 2023)*. This method is used to summarize, average, find patterns, predict and test causal relationships, and generalize results. Initially, the author identifies the business issue at PT CBS and then outlines the research questions and objectives to guide the study. Meanwhile, to collect the data, this study has collected relevant information and data from primary and secondary sources. The internal project details of PT CBS, including revenue, capital expenditures, and operational expenditures, are being used as the primary source of data. Conversely, secondary data is collected from outside companies and similar companies in the same industry. This data covers topics like market risk premiums, country risk-free rates, loan interest rates, applicable taxes, and more. During the data analysis stage, both primary and secondary data will be integrated.

After data and information collection is completed, the information is evaluated using simulations and mathematical calculations to give a comprehensive understanding of the business opportunity's financial setting. The data analysis will encompass several components. These are project cash flow analysis (including revenues, capital expenditures, and operational expenditures), weighted average cost of capital (WACC) assessment, evaluation of net present value (NPV), internal rate of return (IRR), profitability index (PI), payback period (PBP), discounted payback period (DPBP), US index, and sensitivity analysis. In the end, the findings of the data analysis will be used to evaluate the project's financial feasibility and identify important variables that may have significant impacts on it.

Project Financing

Project financing involves raising high capital or funding by combining multiple funding sources. The common sources, which include loans, investments, and various guarantees through a recently established company or partnership, are commonly called the project vehicle. This type of financing is typically employed in developing large-scale, capital-intensive projects and operating specialized businesses. It is frequently used in infrastructure, energy, and industrial projects (Khan & Parra, 2003). Gatti (2023) also states that projects that use this method are usually highly leveraged, and lenders provide most of the funding. Most project financing agreements operate as limited recourse finance. It means lenders can only repay debts based on the cash flow produced by the project and its assets inside the project vehicle. Lenders cannot make claims on the larger assets of the project sponsor if the project vehicle faces difficulties and cannot pay its debts.

Project financing is commonly applied in industries that require significant capital investment and have long payback periods. According to a prior study by Steffen (2018), project finance is essential for developing and managing renewable energy projects, particularly in developed countries like Germany. This is due to project finance's specific financial structure, which helps in risk management for significant renewable energy projects. Lam and Law (2018) state that project financing is important to the renewable energy industry because it allows stakeholders to share risks fairly, gets large scales of funding from multiple sources and focuses on the project's cash flows for repayment. This approach helps financial sustainability and allows public-private collaborations for large-scale projects. Furthermore, infrastructure and transportation projects such as highways, airports, and railways also rely on project financing due to their predictable cash flows generated from user fees or government payments (Gatti, 2023). These examples show how important project financing is.

US Index

The US Index theory is a set of financial parameters that assess a company's repayment ability. The purpose is to decide whether a company should maximize the use of debt or equity, as it shows the real conditions when a company applies for loans to the bank (Siahaan, 2019). The US Index is performed to acknowledge a company’s repayment capability by comparing the Basic Business Profitability (BBP) to the Loan Interest Rates (I). If the US Index scores greater than 1, the company should go into leverage or debt financing, and if it is lower than 1, the company should go into equity financing; if it is equal to 1, the company is free to choose.

$$US\ Index\ = \frac{Basic\ Business\ Profitability\ (BBP)}{Loan\ Interest\ Rate\ (I)}$$

$$BBP = \frac{Earning\ Before\ Interes\ \&\ Taxes}{Total\ Assest} \times\ 100\%$$

Capital Budgeting

Capital budgeting is the method of evaluating and selecting long-term investments that are purposed to increase the wealth of the owners of a company (Gitman and Zutter, 2015). This process involves examining and choosing long-term projects that usually require significant capital and can greatly affect the company's future profits and overall value. There are various approaches to capital budgeting. However, this research will focus on these methods:

Net Present Value (NPV)

The net present value (NPV) of a project is calculated by summing the present values of expected cash flows after it is adjusted for the cost of capital and then subtracting the initial investment. A positive NPV helps to increase the wealth of shareholders. Meanwhile, negative NPV shows an unattractive project. The NPV is formulated as below:

$$\text{NPV} = \sum_{t=1}^{n} \frac{CFt}{(1+r)^t} - CF_0$$

Where:

CF_0 = project's initial investment

CFt = cash inflows

r = discount rate

t = time or period

The Profitability Index (PI)

PI measures how much a project's initial investment compares to the future cash flow. A PI value greater than 1.0 indicates that the project is profitable and should be approved. In simple terms, when the NPV is positive, then the PI will be more than 1.0.

$$PI = \frac{Present\ Value\ of\ Future\ Cash\ Flows}{Initial\ Investment}$$

Internal Rate of Return (IRR)

The discount rate that brings an investment's NPV to zero is the IRR (Gitman and Zutter, 2015). This indicates that the initial investment and the cash stream's present value are equal. Simply put, IRR displays the anticipated yearly growth rate of an investment. The same formulas for calculating NPV are also used to calculate IRR, except the NPV is set to zero. When utilizing IRR to make decisions for the project, if IRR is greater than the cost of capital, then accept the project, and if IRR is lower than the cost of capital, then reject the project.

$$\text{NPV} = 0 = \sum_{t=1}^{n} \frac{CFt}{(1+IRR)^t} - CF_0$$

$$\sum_{t=1}^{n} \frac{CFt}{(1+IRR)^t} = CF_0$$

Payback Period (PBP)

The payback period is the amount of time needed to earn back the initial investment based on the returns or cash flow. This helps to compare various funding alternatives. Generally, a shorter payback period is better because it shows the company can start making a profit sooner.

$$PBP = \frac{Initial\ Investment}{Annual\ Cash\ Flow}$$

Discounted Payback Period (DPBP)

DPBP is the period needed for the present value of an investment's cash inflows to equal its initial cost. In contrast to the conventional payback period, DPBP provides a more realistic evaluation of an investment's profitability by discounting future cash flows to account for the time value of money. Bhandari (2009) stated that DPBP has the consideration of the time value of money and the ability to provide a more comprehensive evaluation of investment projects.

$$DPBP = \frac{Initial\ Investment - Cummulative\ DCF}{Discounted\ Cash\ Flow + 1}$$

Sensitivity Analysis

Sensitivity analysis analyzes how one input variable change can affect the output variables while other input variables remain constant and unchanged. This method is frequently used in capital budgeting to analyze the impact of variations in important factors such as sales, variable costs, fixed costs, cost of capital, and tax rates. These factors can affect the outputs of the project's NPV, IRR, and payback period. Additionally, it helps determine the risks related to a project. Sensitivity analysis is a primary method used to assess assumptions. This method examines how predictions can be affected by changing assumptions. The input variable is considered less important if the assumption modification only slightly affects the prediction. However, it becomes an important variable that needs further investigation and careful consideration if an assumption modification results in a significant change in the expected outcome. Focusing just on the effects of a single variable at a time can be dangerous since it may cause significant assumptions to be missed due to oversimplification.

RESULTS AND DISCUSSIONS

The capital expenditures for installing the on-grid solar PV system cover a wide range of components needed to ensure the successful implementation of the project. A total of IDR 13,459,488,000 is allocated for capex. It includes the procurement and installation of key equipment, including solar PV modules, mounting structures, inverters, and monitoring systems. Additional costs include zero export equipment, distribution panels, cables, and grounding equipment, which collectively form the foundation for the solar PV system's functionality and integration into the grid. Construction and labor expenses are also substantial, which cover labor costs, safety measures, equipment rental, transportation, and operation and maintenance costs. These ensure smooth installation and operational readiness. Administrative and regulatory requirements contribute to the overhead, with permit fees amounting to other overhead costs. Additionally, VAT is included, adhering to tax regulations. Furthermore, the projected annual operating expenses come to IDR 315,000,000. The majority of this cost is attributed to the operational and maintenance (O&M) expenses. Considering the initial investment has already taken other expenses into account.

The projected revenue of the solar PV project is based on the energy generated and the electricity price. The projected revenue for PT CBS's solar PV project is calculated based on the system's capacity, annual power generation, and the prevailing electricity price. With a total capacity of 1.881 MWp, the system is expected to produce 2,821,500 kWh annually, leveraging its efficiency and consistent performance. At an electricity price of 1,115 IDR/kWh (PLN, 2025), this translates into an annual revenue of approximately IDR 3,145,126,050.

In capital budgeting, long-term investments that aim to increase the owner's wealth are evaluated and selected. Three primary indicators will be used to assess the economic feasibility of these investments. These are NPV, IRR, and PBP. To evaluate these three indicators, the project's lifetime free cash flow (FCF) must be calculated. After that, the discounted free cash flow must be calculated by applying a selected discount factor to the FCF once it has been calculated over the lifetime of the project. Assuming that there is no debt and that equity takes for 100%, the discount rate is calculated from the cost of capital.

Table 1. Project Cash Flow Statement

PROJECT CASH FLOW STATEMENT		
OPERATIONAL ACTIVITIES		
Total Revenue	IDR	3,145,126,050
Total Operating Cost	IDR	506,657,734
EBITDA	IDR	2,638,468,316
Depreciation	IDR	538,379,520
EBIT	IDR	2,100,088,796
Interest Expense	IDR	-
Taxes	IDR	462,019,535
NOPAT	IDR	1,638,069,261

Based on the analysis, the project shows positive financial results for the 25 years of operational activities. The project cash flows, both in total and discounted form, show that the project generates added value over time. The payback period is 5.82 years. Meanwhile, the discounted payback period, which considers the time value of money using discounting, is 13.93 years. Although longer, it shows the important impact of the time value of money on the return on investment. The project has an NPV of IDR 1,801,083,714, which is the net cash value after accounting for all project cash flows and initial investment. When the NPV result shows greater than zero (positive value), it means the project is acceptable as it generates a net profit. The PI of 1.13 also supports the feasibility of this project, indicating that each unit of investment generates more than one unit of profit. In addition, the project's IRR stands at 16.7% per annum, which is higher than the WACC of 14,52%. This means that the project provides a higher rate of return than the cost of capital, making it profitable to continue. Based on the analysis above, the project is feasible.

Although the feasibility analysis previously performed was based on full equity financing, PT CBS may explore the possibility of using debt financing for this project. In the US Index calculation, the average earnings before interest and tax (EBIT) of the project is IDR 2,203,164,753, with total project assets of IDR 13,459,488,000. The rate of return on equity (BBP) is assumed to be 16,37%. For the US Index analysis, the author uses an interest rate of 8.72% based on an assumption of the domestic bank financing rate in Indonesia (CEIC Data, 2024).

Table 2. US Index Calculation

Average EBIT	IDR	2,203,164,753
Total Asset	IDR	13,459,488,000
BBP		16.37%
Interest rate		8.72%
US Index		1.88

The calculation results show that the US Index score is 1.88, which is higher than 1. This shows that leverage can have a positive impact on project profitability with low financial risk. This value also indicates that the project has sufficient capacity to meet its debt repayment obligations. Furthermore, since the interest rate on the loan is 8.72%, based on the domestic bank interest rate, which is lower than the rate of return on equity (16.37%), the use of debt may be a more financially efficient option than using

equity capital entirely. Thus, debt-based financing may be an effective alternative to help the project continue to be feasible and profitable.

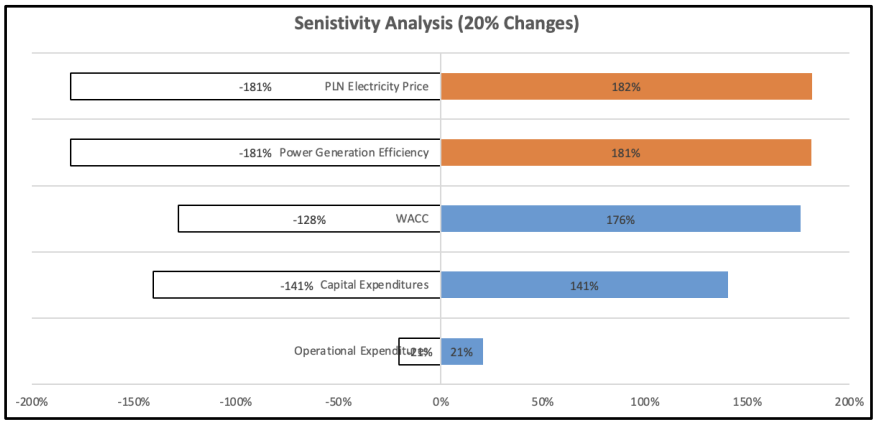

Figure 1. Sensitivity Analysis

The sensitivity analysis is conducted to know which variables are the most crucial to be controlled. A variety of variables that are believed to influence the economic feasibility of PT CBS's solar PV installation project have been chosen. These variables include the variation of capital expenditures, operational expenditures, PLN electricity prices, power generation efficiency, and WACC. The result shows that PLN electricity price and power generation efficiency are equally sensitive to project feasibility. A 20% decrease leads to a negative NPV of IDR 1,464,174,678. Similarly, a 20% decrease resulted in the same negative NPV. Conversely, a 20% increase in PLN electricity prices raises NPV to IDR 5,071,614,793 (182% increase). An increase in power generation efficiency by 20% boosts NPV to IDR 5,066,342,105. From this, it shows that PLN electricity price and power generation efficiency are crucial for project sustainability.

Furthermore, NPV is strongly affected by the variation in PLN electricity price and power generation efficiency. Changes in WACC and capital expenditure also have a considerable effect. In contrast, variations in operational expenditures provide a moderate to low impact. IRR is most influenced by changes in power generation efficiency and PLN electricity price. Variations in capital expenditures have a moderate effect, while changes in operational expenditures and WACC have minimal impact. PBP is moderately affected by power generation efficiency and PLN electricity price. Capital expenditures have a smaller effect, while operational expenditures exhibit the least impact, varying by only. Changes in WACC have no impact on PBP.

Table 3. Summary of Sensitivity Analysis

Variables	Impact to NPV		Impact to IRR		Impact to PBP	
	Variation -20%	Variation +20%	Variation -20%	Variation +20%	Variation - 20%	Variation +20%
Capital Expenditures	141%	-141%	26%	-18%	-19%	19%
Operational Expenditures	21%	-21%	3%	-3%	-2%	2%
PLN Electricity Price	-181%	182%	-24%	23%	27%	-18%
Power Generation Efficiency	-181%	181%	-24%	23%	27%	-18%
WACC	176%	-128%	0%	0%	0%	0%

In this study, four different scenarios for the funding source are simulated. These are internal financing (full equity), domestic bank loans, international bank loans, and leasing. The calculations are performed using various debt and equity ratios. Among the options, internal financing provides a high WACC (14.52%). This is reasonable due to the equity's high cost of capital. Then, this option produces the second-lowest NPV of IDR 1,801,083,714. Although the IRR matches the project's return at 16.70%, the DPBP is significantly longer at 13.93 years, making the option less favorable compared to the others. The feasibility of domestic bank loans is improved by a second lower WACC of 11.43% when compared to options 1 and 4. This results in a greater NPV of IDR 5,213,336,058, even though it is lower than international bank loans. While the DPBP is at 10.17 years, the IRR remains at 16.70%. This option balances cost efficiency and financial viability without compromising control. International bank loans result as the most favorable option, with the lowest WACC of 10.58%, the highest NPV of IDR 6,391,529,026, and the shortest DPBP of 9.56 years. This funding strategy provides the best financial returns due to low interest rates and maximizes project profitability. On the other hand, leasing turns out to be the least feasible option due to its high WACC of 14.52%, minus NPV IDR 879,545,252. and DPBP of more than 25 years. Significant long-term cost burdens are shown by the IRR of 9.10%, which is also significantly lower than the project's expected return.

Domestic bank loans, however, offer a fair substitute, although one that is less favorable. Meanwhile, internal financing and leasing are less favorable due to higher costs, lower returns, and longer payback periods, making them less ideal unless other financing options are unavailable. In conclusion, the option of getting a loan from the International Bank is recommended. Based on the analysis, the option to get a loan from an international bank with a composition of 40% debt and 60% equity is the best option for this project. This option provides the highest NPV, the lowest WACC, and the shortest discounted payback period.

Table 4. Comparison of Funding Source Profitability

Funding Source Options	WACC	NPV	IRR	PBP (Years)	DPBP (Years)
Internal Financing	14.52%	IDR 1,801,083,714	16.70%	5.82	13.93
Domestic Bank Loans	11.43%	IDR 5,213,336,058	16.70%	5.82	10.17
International Bank Loans	**10.58%**	**IDR 6,391,529,026**	**16.70%**	**5.82**	**9.56**
Leasing	14.52%	IDR (879,545,252)	9.10%	9.74	>25

This study recommends PT CBS fund the project with an international bank loan with a 60:40 debt-to-equity ratio. The first reason is that a full equity utilization will put pressure on shareholders' cash flow and reduce their liquidity. To allow the remaining shareholder equity to be used for other operational activities and to prepare for future economic challenges, the equity portion of the project funding must be controlled up to a particular limit. The second one is because an international bank loan lowers the WACC value and gives an attractive interest rate. Furthermore, the project's viability continues to be attractive due to its high NPV, reasonable PBP, and the IRR being higher than WACC. However, suppose this

funding source selection proves too challenging. In that case, there is nothing wrong with utilizing the other options, which include domestic banks as the second and full equity financing as the third option.

CONCLUSION

The on-grid PV solar panel installation project that is going to be built by PT CBS is economically feasible. The feasibility analysis performed brings results to all the project indicators that remain feasible. NPV is greater than zero, IRR value at 16.7%, payback period at 5.82 years, and discounted payback period at 13.93 years. Furthermore, the optimum financing strategy for this project is to get a loan from an international bank with a composition of 40% debt and 60% equity. This option provides the highest NPV and the shortest discounted payback period among the other options.

After the completion of the study and understanding of the findings in this final project, the author has summarized a list of recommendations that PT CBS and future studies can implement. Below are the recommendations for PT CBS:

- Coordinate with the parent company to propose leveraging debt from international bank loans since they offer lower interest rates and can provide access to larger capital sources. While leasing is not preferred due to higher long-term costs, full equity financing is less efficient due to a higher cost of capital.
- Maintain the debt-to-equity ratio around 60:40 to integrate the funding sources of shareholder equity and debt financing, which is a loan from an international bank. This is to determine if the project remains feasible.
- Focus on operational efficiency, as power generation efficiency in the operational is one of the key sensitivity factors. PT CBS must monitor systems to maintain high power generation efficiency and reduce performance degradation over the years. Using advanced technology and monitoring systems to minimize efficiency losses and ensure consistent electricity output throughout the project's lifespan.
- Manage proper management of construction activities to avoid delays. Delay in the construction completion will require more cost, delaying the revenue generation from the facility production. PT CBS should appoint a dedicated project management team to oversee the implementation and ensure completion within the proposed 12–18 month timeline.
- During project execution, make sure the mitigation plan and actions are in place, implement risk management properly, and monitor for any new risks.

Furthermore, an analysis of other new possible funding sources and alternative financing plans that might be used for projects of similar scope is suggested for future studies.

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